



U.S. Department
of Transportation
**Federal Aviation
Administration**

Detroit Airports District Office
11677 South Wayne Road
Suite 107
Romulus, MI 48174

July 8, 2016

Mr. Tim Howen, Airport Manager
Ford Airport
P. O. Box 609
Iron Mountain, Michigan 49801

Dear Mr. Howen:

Ford Airport, Iron Mountain, MI
AIP Project No. Future
Runway 13/31 Crack Repair
Approval of State Highway Hot Mix Asphalt

Enclosed is one unconditionally approved copy of the P-403 Modification of Standard request for the Runway 13/31 Crack Repair project.

Please be aware that this approval only applies to the subject project.

Sincerely,

ORIGINAL SIGNED BY

Irene Porter
Program Manager, Detroit Airports District Office

Enclosure

cc: MDOT – Carol Aldrich ✓

RECEIVED

JUL 11 2016

**Aviation Services
Division**

[illegible]

FAA GREAT LAKES REGION
MODIFICATION OF AIRPORT DESIGN STANDARDS
 COMPLETE FORM IN CONJUNCTION WITH THE USER GUIDE

BACKGROUND		
1. AIRPORT: Ford Airport	2. LOCATION (CITY, STATE): Iron Mountain, Michigan	3. LOC ID: IMT
4. AFFECTED RUNWAY/TAXIWAY: Runway 13/31 (3,809'x75')	5. APPROACH (EACH RUNWAY): 1/19 PIR 13/31 NPI	6. AIRPORT REF. CODE (ARC): Runway 1/19 C-III Rwy 13/31 is B-II
7. DESIGN AIRCRAFT (EACH RUNWAY/TAXIWAY): Rwy 1/19 DC9/B727 Rwy 13/31 King Air B200		
MODIFICATION OF STANDARDS		
8. TITLE OF STANDARD(S) BEING MODIFIED (CITE REFERENCE DOCUMENT): FAA Advisory Circular 150/5370-10G Item P-403 Hot Mix Asphalt (HMA) Pavements		
9. STANDARD/REQUIREMENT: This specification is intended to be used for the surface course for airfield flexible pavements subject to aircraft loadings of gross weights greater than 12,500 pounds (5670 kg) and is to apply within the limits of the pavement designed for full load bearing capacity. This runway is designed for weights 12,500 pounds and less. See attached.		
10. DESCRIPTION OF PROPOSED MODIFICATION: Modification to allow State Highway HMA Mix to be used for runway major crack repair / patching.		
11. EXPLAIN WHY STANDARD(S) CANNOT BE MET: The project has approximately 1,140 SYD of major crack repair / patching at 4" deep. The cost of the mix design and associated requirements for asphalt patching are not cost effective. The airport intends to complete a future project that fully rehabilitates the entire Runway 13/31 with P-401/403.		
12. DISCUSS ALL VIABLE ALTERNATIVES: Use of unmodified P-401/403 Specifications would be cost prohibitive.		
13. ASSURANCE THAT MTS WILL PROVIDE AS OUTLINED IN THE 'USER GUIDE': Allowable application under construction standards. State Highway Specification has proven suitable.		
ATTACH ADDITIONAL SHEETS AS NECESSARY -- INCLUDE SKETCH/PLAN		

FAA GREAT LAKES REGION MODIFICATION OF AIRPORT DESIGN STANDARDS

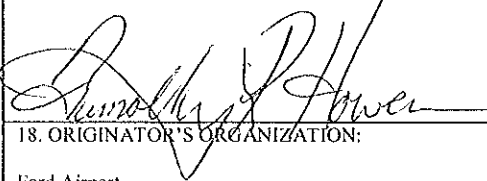
14. Skip to Question 15 if request is not for a Modification To Material Standards or Construction Methods.

CHECK WHEN APPLICABLE

<input type="checkbox"/>	Modifications to materials standards is requested because locally available materials cannot meet the requirements of that standard.
<input checked="" type="checkbox"/>	Modifications to construction methods standards will result in cost savings and/or greater efficiency.
<input type="checkbox"/>	Bids have already been received for this project.

IF ANY OF THE ABOVE IS CHECKED PLEASE PROVIDE ADDITIONAL DETAILS.

Modification will provide significant cost reduction for the project. Per standard, testing and material requirements are excessive for the small quantity, and State Highway Specification is allowed by standard.

15. SIGNATURE OF ORIGINATOR: 	16. PRINTED NAME OF ORIGINATOR Tim Howen - Airport Manager	17. DATE 6-28-16
18. ORIGINATOR'S ORGANIZATION: Ford Airport	19. TELEPHONE (906) 774-4870	20. E-MAIL thowen58@hotmail.com
21. DATE OF LATEST FAA SIGNED ALP: January 30, 2013		

BELOW IS TO BE COMPLETED BY FAA

22. ADO RECOMMENDATION: <i>Unconditional Approval</i>	23. SIGNATURE: <i>Kene R Porter</i>	24. DATE: <i>6/28/16</i>
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25. FAA DIVISIONAL REVIEW (AT, AF, FS, etc.):

ROUTING SYMBOL	SIGNATURE	DATE	CONCUR	NON-CONCUR
AGL-622	<i>[Signature]</i>	06/28/2016	X	

COMMENTS:

26. AIRPORTS' DIVISION FINAL ACTION:

<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
UNCONDITIONAL APPROVAL	CONDITIONAL APPROVAL	DISAPPROVAL

DATE: <i>7-1-2016</i>	SIGNATURE: <i>[Signature]</i>	TITLE: <i>MANAGER, DETROIT ADO</i>
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CONDITIONS OF APPROVAL:

Porter, Irene (FAA)

From: Lambiasi, Carlton (FAA)
Sent: Tuesday, June 28, 2016 2:27 PM
To: Porter, Irene (FAA)
Cc: aldrichc@michigan.gov
Subject: RE: IMT Runway 13/31 HMA - State DOT Mix
Attachments: IMT-HMA-Draft-MOS_2016-06-28_RO APPROVED.pdf

No problem. Approval attached.

Regards,
Carlton

From: Porter, Irene (FAA)
Sent: Tuesday, June 28, 2016 12:40 PM
To: Lambiasi, Carlton (FAA)
Cc: aldrichc@michigan.gov
Subject: FW: IMT Runway 13/31 HMA - State DOT Mix
Importance: High

Carlton

We are proposing to do a Major Crack Repair project on runway 13/31 and Ford Airport (IMT), Iron Mountain, Michigan. The sponsor is requesting to use MDOT State Highway Mix for this project because the tonnage is so small. The ADO supports this request for the following reasons: 1) this is crack repair, 2) Runway 13/31 is for 12,500 and under, 3) there will be a future project to do a 2" mill/fill all of Runway 13/31 with P-401/403.

Attached is a draft MOS (Not sure if we need one as it appears to be allowed in P-401) but thought this was the best instrument to use for a quick review. We are requesting permission to move ahead with a State DOT mix for the major crack repair of Runway 13/31 at IMT.

Irene Porter
Program Manager
Detroit Airports District Office
Federal Aviation Administration
11677 South Wayne Road, Suite 107
Romulus, Michigan 48174

Phone: (734) 229-2915
Fax: (734) 229-2950

Item P-403 Hot Mix Asphalt (HMA) Pavements (Base, Leveling or Surface Course)

This specification contains options for both Marshall and Gyratory Mix Design Methods. The Engineer shall select the appropriate options for the selected mix design method.

DESCRIPTION

403-1.1 This item shall consist of a [____] course composed of mineral aggregate and asphalt cement binder (asphalt binder) mixed in a central mixing plant and placed on a prepared course in accordance with these specifications and shall conform to the lines, grades, thicknesses, and typical cross-sections shown on the plans. Each course shall be constructed to the depth, typical section, and elevation required by the plans and shall be rolled, finished, and approved before the placement of the next course.

Specify base and/or leveling course. Surface course may also be specified but only for those pavements designed to accommodate aircraft of gross weights less than or equal to 12,500 pounds (5670 kg) or for surface course of shoulders, blast pads, service roads, etc., Item P-401 shall be specified for surface courses for pavements designed to accommodate aircraft gross weights greater than 12,500 pounds (5670 kg).

This specification is to be used as a base or leveling course for pavements designed to accommodate aircraft of gross weights greater than 12,500 pounds (5670 kg).

State highway department specifications may be used in lieu of this specification for access roads, perimeter roads, stabilized base courses under Item P-501, and other pavements not subject to aircraft loading, or for pavements designed for aircraft gross weights of 12,500 pounds (5670 kg) or less.

Where a state highway department material specification is used in lieu of this specification, the state specification must have a demonstrated satisfactory performance record under equivalent loadings and exposure. When a density requirement is not specified by a state specification, it shall be modified to include the language found in paragraphs 403-5.1, 403-5.2 and 403-5.3. When state highway specification are approved, include all applicable/approved state specifications in the contract documents. Update any references to State Department of Transportation (DOT), State Materials Laboratory, etc., to "Owner," "Engineer," etc. as appropriate for project. The use of state highway department specifications requires a modification to standards.

Section 501. PLANT PRODUCED HOT MIX ASPHALT

501.01. Description. This work consists of providing and placing Hot Mix Asphalt (HMA) mix using Superpave Mixture Design Methods.

A. Terminology.

Broken Aggregate. Cracked aggregate caused by construction operations.

Crack. A visible fissure of varying length and orientation in the HMA, partially or completely through at least one course.

Flushing. A shiny or reflective condition, tacky to the touch, appearing on the HMA surface when asphalt binder collects in the voids at high pavement temperatures.

HMA Mix Design. The selection and proportioning of aggregates, mineral filler, Reclaimed Asphalt Pavement (RAP), and asphalt binder to meet the mix design criteria required by the contract.

HMA Segregation. Areas of HMA pavement exhibiting non-uniform distribution of coarse and fine aggregate particles, visually or otherwise identifiable.

Job Mix Formula (JMF). An HMA mix for a specific project, including adjustments to optimize the field application.

Lot. A discrete tonnage of one mix, typically made up of five sublots.

Pavement. The completed HMA placement, including layers on driving lanes and shoulders.

Pavement Edge. The extremity boundaries of the pavement.

Roller Cracking. High density surface map-cracking that appears immediately after rolling.

Rutting. A depression or displacement of the HMA surface that occurs in a longitudinal direction or a localized area.

Sublot. A portion of a lot represented by a complete set of quality assurance tests.

Target Value. A JMF parameter value that may be adjusted, if approved by the Engineer, to account for changes in the physical properties of the mixture.

501.02. Materials. Provide materials in accordance with the following:

Superpave HMA Mixtures.....902

501.02

Superpave Aggregates.....	902
Mineral Filler, 3MF.....	902
Anti-Foaming Agent.....	904
Asphalt Binders	904
Bond Coat, SS-1h, CSS-1h.....	904

Plant produced HMA consists of asphalt binder, aggregates, mineral filler, and other additives.

Provide release agents that do not harm the HMA mixture. Do not use fuel oil or other distillate derivatives.

Provide the HMA mix type and the performance grade of asphalt binder as required by the contract.

Provide blended aggregates for HMA top course mixtures, except top courses for shoulders, bike paths, temporary roads, and parking areas, meeting the required Aggregate Wear Index (AWI).

A. Composition of HMA Mixtures.

1. **Mix Design.** Develop an HMA mix design in accordance with the *HMA Production Manual* and submit to the Department. The Department will evaluate the design in accordance with Section 1 of the *HMA Production Manual*, "Procedures for HMA Mix Design Processing."

Provide written certification that the materials in the mix design are from the same source and meet the material properties in the mix design or the Department-approved JMF. Ensure that all JMF adjustments are in accordance with the *HMA Production Manual*.

The Contractor may use mix designs approved by the Department on other projects, if approved by the Engineer. Provide combined aggregate blends meeting the properties specified in section 902. Provide a mix design that meets the requirements of Table 501-1, Table 501-2, and Table 501-3 as applied to combined aggregate blends.

For mix design purposes, top and leveling courses are the mix layers within 4 inches of the surface. The base course consists of the layers below 4 inches from the surface. For mix layers within the 4-inch threshold, if less than 25 percent of the mix layer is within 4 inches of the surface, the mix layer is a base course.

For projects that specify a mix type E03, the Contractor may use a mix type LVSP.

If High Stress HMA is shown on the plans, provide the same mix design as required for the mainline top and leveling courses, except change the performance graded binder as shown on the HMA application table.

Table 501-1 Superpave Mix Design Criteria					
Design Parameter	Mix Number				
	5	4	3	2	LVSP
Percent of Maximum Specific Gravity (%G _{mm}) at the design number of gyrations, (N _d) (c)	96.0% (a)				
%G _{mm} at the initial number of gyrations, (N _i)	See Table 501-3				
%G _{mm} at the maximum number of gyrations, (N _m)	98.0%				
VMA min % at N _d (based on aggregate bulk specific gravity, (G _{sb})) (c)	15.00	14.00	13.00	12.00	14.00
VFA at N _d	See Table 501-2 (b)				
Fines to effective asphalt binder ratio (P _{No200} /P _{bs})	0.6–1.2				
Tensile strength ratio (TSR)	80% min				
a. For mixtures meeting the definition for base course, design mixtures to 96.0% of Maximum Specific Gravity %G _{mm} at the design number of gyrations, (N _d). During field production, increase %G _{mm} at the design number of gyrations, (N _d) to 97.0%.					
b. For base course or regressed shoulder mixtures, the maximum criteria limits do not apply.					
c. Lower Target Air Voids by 1.0% if used in a separate shoulder paving operation, unless otherwise shown on the plans.					

Table 501-2 VFA Minimum and Maximum Criteria			
Estimated Traffic (million ESAL)	Mix Type	Top & Leveling Courses	Base Course
≤0.3	LVSP	70–80	70–80
≤0.3	E03	70–80	70–80
>0.3 – ≤1.0	E1	65–78	65–78
>1.0 – ≤3.0	E3	65–78	65–78
>3.0 – ≤10	E10	65–78 (a)	65–75
>10 – ≤30	E30	65–78 (a)	65–75
>30 – ≤100	E50	65–78 (a)	65–75
a. The specified VFA range for mix Number 5 is 73%–76%.			

Table 501-3 Superpave Gyrotory Compactor (SGC) Compaction Criteria					
Estimated Traffic (million ESAL)	Mix Type	%G _{mm} at (N _i)	Number of Gyration (a)		
			N _i	N _d	N _m
≤0.3	LVSP	91.5%	6	45	70
≤0.3	E03	91.5%	7	50	75
>0.3 – ≤1.0	E1	90.5%	7	76	117
>1.0 – ≤3.0	E3	90.5%	7	86	134
>3.0 – ≤10	E10	89.0%	8	96	152
>10 – ≤30	E30	89.0%	8	109	174
>30 – ≤100	E50	89.0%	9	126	204
a. Compact mix specimens fabricated in the SGC to N _d . Use height data provided by the SGC to calculate volumetric properties at N _i . Compact mix specimens at optimum P _b to verify N _m for mix design specimens only.					

2. **Recycled Mixtures.** The Contractor may substitute Recycled Asphalt Pavement (RAP) for a portion of the new material required to produce HMA mixture. Design and produce the mix to meet the criteria in this subsection and the contract.

- a. **Stockpile Requirements.** Process RAP to the size required for the specified HMA mix. Ensure the stockpile contains enough material to produce the recycled mixtures the Engineer approves for the project. If the RAP stockpile is not sufficient to produce recycled mix quantities required for the project, provide an Engineer-approved mix design without RAP at the same unit price.

Provide documentation of testing and accumulated tonnage in the stockpile to the MDOT laboratory. The Contractor may estimate the tonnage. The Department will begin evaluating the mix design after receipt of the documentation.

- b. **Mix Design.** Submit required documentation for recycled mix designs in accordance with Section 1 of the HMA Production Manual, "Procedures for HMA Mix Design Processing."

B. HMA Plant Certification. Ensure hot mix asphalt plants are certified by the Department at least 3 work days before mix production begins. The Engineer will certify hot mix asphalt facilities in accordance with Section 2 of the HMA Production Manual, "Certification Procedure of HMA Plants." Post a seal of certification in the plant control office.

C. HMA Production. Submit an approved mix design for the mix required to the Engineer at least 2 work days before production begins.

Ensure even heating of the mass of asphalt binders and maintain heat control. Heat asphalt binders to the temperature required for the type of binder, except ensure that neither the asphalt binder nor the HMA

exceed the maximum temperature specified in Table 904-7. The Department will reject asphalt binder and mix if the temperature exceeds the maximum specified in Table 904-7. The Department will reject contaminated asphalt binder.

Stockpile aggregates at the facility, in a manner that prevents segregation. Dry aggregates to a moisture content that will ensure an appropriately coated HMA mix. For batch and continuous plants, the Department will reject aggregates in the hot bins that contain sufficient moisture to cause foaming or a water-saturated mixture. Remove rejected materials from the bins.

Place uniform gradations of aggregates in the cold feed system. If providing a blend of aggregates for the mix by combining aggregates from at least two cold feed bins, ensure the blend meets the combined gradation (from JMF) quality control tolerances.

The Engineer will allow the use of at least one hot aggregate bin to proportion aggregates to meet the JMF tolerances, if the cold feed requirements are met.

501.03. Construction.

A. Equipment. Provide equipment in accordance with section 107, capable of producing pavement that meets the requirements of this section.

1. **Cold-Milling Machines.** Provide equipment that consistently removes the HMA surface, in one or more passes, to the required grade and cross section, and produces a uniformly textured surface. Provide machines equipped with the following:
 - a. Automatically controlled and activated cutting drums, and
 - b. Grade reference and transverse slope control capabilities.
2. **Hauling Equipment.** Ensure transport trucks are equipped to protect the mix from the weather and retard the loss of heat.
3. **Pressure Distributor.** Provide a pressure distributor in accordance with subsection 505.03.A.1.
4. **Pavers.** Equip each paver with a full-width vibratory or tamper bar screed capable of spreading and finishing HMA to the required cross section and grade. Use a paver that produces a uniformly finished surface, free of tears, other blemishes, and measurable segregation.

Equip the paver to provide a uniform head of material ahead of the screed. Install reverse pitch augers or paddles inside the ends of the auger shafts to force the mix to the center of the main screed.

501.03

Ensure extensions, added to the main screed, provide the same vibrating or tamping action and heating capabilities as the main screed. Adjust extensions to the main screed so, after breakdown rolling, no longitudinal marks remain on the surface. Equip in-line screed extensions with a continuation of the automatically controlled spreading augers to within 12 inches of the outside edge. Follow the manufacturer's recommendations for other screed extensions.

Except for the paving operations listed in subsection 501.03.F.1.a through subsection 501.03.F.1.d, equip pavers with an automatically controlled and activated screed with grade reference and transverse slope control. Use an Engineer-approved grade referencing attachment, at least 30 feet long, for lower courses and the first pass of the top course. Ensure the Engineer approves alternate grade referencing attachments before use.

After placing the first pass of the top course, the Contractor may, with prior approval from the Engineer, substitute a joint matcher, a grade referencing attachment at least 10 feet long, or other grade referencing equipment for constructing adjacent passes of the top course.

5. Rollers.

- a. **Steel-Wheeled Rollers.** Provide self-propelled vibratory steel-wheeled rollers, static tandem rollers, or self-propelled static three-wheeled rollers. Provide a steering device that allows the roller to follow the established alignment. Equip rollers with wheel sprinklers and scrapers. Provide smooth roller wheels, free of openings or projections that will mar the pavement surface.

Provide vibratory rollers with an automatic shutoff to deactivate the vibrators if the roller speed decreases below ½ mph. Provide rollers that operate in accordance with the manufacturer's recommended speed, impacts per foot, and vibration amplitude for the thickness of HMA mix.

- b. **Pneumatic-Tired Rollers.** Provide self-propelled pneumatic-tired rollers. Equip rollers with at least seven wheels spaced on two axles so the rear group of tires does not follow in the tracks of the forward group, providing at least ½-inch tire path overlap. Provide smooth tires capable of being inflated to the pressure recommended by the roller or tire manufacturer. Equip the rollers with a mechanism that can smoothly reverse the motion of the roller.

Equip the rollers with wheel scrapers and skirting to enclose the wheels to within 3 inches of the pavement surface. Use a release agent to prevent material from sticking to the tires and being deposited on the top course pavement during rolling.

- c. **Combination Rollers.** The Contractor may use combination pneumatic-tired and steel-wheeled rollers manufactured specifically for HMA compaction, if equipped with the required sprinklers and scrapers.
- 6. **Spreaders.** Use self-propelled spreaders capable of pushing the hauling units. Ensure spreaders can maintain the required width, depth, and slope, without causing segregation.
- 7. **Material Transfer Device.** When a Material Transfer Device (MTD) is required, it must be capable of delivering HMA mix from the truck transport to the paver hopper to ensure constant paver speed, remixing HMA material using manufacturer's developed technology, and depositing material in the paver hopper. Provide a paver hopper insert with at least a 10 ton capacity in the paver and keep at least one-third full of mix during paving.
- 8. **Compressed Air System.** If a compressed air system is required for cleaning pavement, equip the air compressor with a moisture separator to remove oil and water from the air supply. Provide a compressor capable of producing at least 100 psi and continuous 150 cfm airflow.
- 9. **Miscellaneous Equipment.** Provide a straightedge at least 10 feet long and other tools to finish the work.
- 10. **Lights on Equipment.** If maintaining traffic on HMA construction, equip equipment within the project, including cold-milling machines, distributors, and rollers, with at least one Department-approved flashing, rotating, or oscillating amber light. Equip pavers with at least one light on each side. Mount the lights so the warning signal is visible to traffic in every direction. Operate the lights while work is in progress. Ensure hauling units activate four-way flashers on the project.
- B. **Preparation of Base.** Provide subgrade, subbase, aggregate base course, crushed and shaped base, or rubblized base in accordance with the relevant sections of Division 2 and Division 3, before HMA placement.
- C. **Preparation of Existing Pavement.** Prepare the existing surface as required to construct HMA pavements, shoulders, and approaches.

501.03

1. **Drainage Structures, Monument Boxes, and Water Shutoffs.** Adjust, temporarily lower, or both, catch basins, manhole covers, monument boxes, and water shutoffs in accordance with subsection 403.03.A.

2. **Cleaning Pavement.** Using methods approved by the Engineer, clean dirt and debris from the pavement surface and paved shoulders before placing HMA. Remove loose material from joints and cracks using compressed air.

If the Engineer determines the compressed air system will not remove deleterious material, remove loose material by a hand or mechanical method, as approved by the Engineer. The Department will pay for removal of material by hand or mechanical methods in accordance with subsection 501.04.E.

Do not place HMA until the Engineer inspects and approves the condition of the existing pavement.

3. **Removing Existing Pavement for Butt Joints.** If a butt joint is required, remove the existing surface to the thickness of the proposed overlay, for the full width of the joint. Uniformly taper the removal to the original surface over at least 35 feet.
4. **Edge Trimming.** For required removal of HMA shoulder material or no greater than 1 foot width of HMA pavement, cut the HMA material full depth along the pavement edge or removal line to prevent tearing the pavement surface. Cut joints, where the completed surface will be exposed, with a saw, cold-milling machine, or other methods approved by the Engineer. Cut joints, where the completed surface will be covered by HMA mix, with a coultter wheel, saw, cold-milling machine, or other method approved by the Engineer.
5. **Cold-Milling HMA Surfaces.** Before milling existing pavement, obtain a Department-approved mix design in accordance with subsection 501.02.A, and ensure the availability of HMA mix quantities to cover milled surfaces.

Remove the HMA surface to the depth, width, grade, and cross section shown on the plans. Backfill and compact depressions resulting from removal of material below the specified grade, in accordance with subsection 501.03.C.9.

If the milling machine discovers buried structures within the specified grade, such as valve boxes, manholes, or railroad tracks that are not identified on the plans, the Department will pay for all associated costs, as extra work, in accordance with subsection 103.02.

Immediately after cold-milling, clean the surface. Dispose of removed material in accordance with subsection 104.07.D and subsection 204.03.

6. **Removing HMA Surface.** Except as specified in subsection 501.03.C.4, removing HMA surface applies to removing HMA overlying a base course that is to remain in place.

Cut joints, exposed in the completed surface, with a saw or cold-milling machine. Cut joints, covered by HMA mix, with a coultter wheel, saw, or cold-milling machine. Obtain the Engineer's approval of alternate methods for cutting joints.

When removing HMA overlying a base course that is to remain in place, cut the edges of the surface requiring removal along straight lines for the full depth of the HMA surface.

When removing HMA by cold-milling, the Engineer may direct the Contractor to remove less than the full depth of HMA surface.

7. **Removing HMA Patches.** Remove patches that may compromise the performance of the overlay.
8. **Joint and Crack Clean Out.** If the plans show joint and crack clean out, use mechanical or hand methods to remove joint sealants to at least 1 inch deep. Remove vegetation, dirt, and debris that cannot be removed using the methods specified in subsection 501.03.C.2, from transverse and longitudinal joints and cracks. Use hand patching to fill cleaned joints and cracks at least 1 inch wide.
9. **Hand Patching.** If the contract requires hand patching, fill holes, depressions, joints, and cracks in the existing pavement and replace existing patches. Compact the hand patching material in no greater than 3 inch layers to the adjacent pavement surface grade using a machine vibrator or Department-approved roller. Use top course or other Engineer-approved mix for hand patching material.
10. **Repairing Pavement Joints and Cracks.** Repair joints and cracks as required.

D. Bond Coat. Uniformly apply the bond coat to a clean, dry, surface with a pressure distributor. Obtain the approval of the Engineer for the application rate after work begins. Apply the bond coat ahead of the paving operation to allow the bond coat to cure before placing HMA.

Do not leave pools of bond coat on the surface and do not spray the bond coat on adjacent pavement surfaces. Apply the bond coat to each

501.03

HMA layer and to the vertical edge of the adjacent pavement before placing subsequent layers.

E. Transportation of Mixtures. Weigh each load of HMA, accepted by the Department, to the nearest 20 pounds on an approved scale with an automatic printout system. Provide a scale and printout system for platform and suspended scales in accordance with subsection 109.01.B.6.

Apply a release agent, in accordance with subsection 501.02, to hauling units. The Engineer will reject loads with excessive amounts of release agent. Do not place crusted HMA in the paver.

The Department will reject loads with a temperature either below 250 °F or greater than ± 20 °F from the recommended maximum mixing temperature specified by the binder producer at the time of discharge from behind the screed.

F. Placing HMA.

1. **General.** Provide a pavement as shown on the plans.

Place HMA on a cured bond coat using pavers in accordance with subsection 501.03.A.4, unless placing mixtures for the following:

- Variable width sections;
- The first course of a base course mix on a subgrade or sand subbase;
- Base course mixtures for shoulders and widening less than 10½ feet wide; or
- Top and leveling course mixes for shoulders and widening less than 8 feet wide.

Place HMA mix in layers, and do not exceed the application rate. If the application rate for an HMA pavement exceeds the maximum rates specified in Table 501-4, and the edges are not confined, construct the pavement in at least two layers.

Table 501-4 HMA Application Rates		
Mix Number	Course Application	Application Rate, (lb/yd ²) minimum–maximum (a)
2	Base	435–550
3	Base, Leveling	330–410
4	Leveling, Top	220–275
5	Top	165–220
LVSP	Leveling, Top	165–250
LVSP	Base	220–330
a. Minimum application rates do not apply to wedging courses.		

Wedge with HMA to remove irregularities in the existing road surface. Place and compact HMA wedging to correct the foundation. Allow the wedging to cool enough to support construction equipment without causing visible distortion of the mat before placing subsequent wedging, base, leveling, or top course mixtures.

Place HMA mix to the slope and width shown on the plans. Place subsequent HMA course to align the vertical edge with the previous courses, without constructing a ledge. Correct ledges that result from placing material in excess of the width shown on the plans at no additional cost to the Department.

Place shoulder aggregate and compact flush after placement of each layer of HMA at the end of the paving day or place traffic control devices in accordance with subsection 812.03, at no additional cost to the Department. Complete final shaping and compaction of the shoulders after placing the top course of HMA.

If delays slow paving operations and the temperature of the mat immediately behind the screed falls below 200 °F, stop paving and place a transverse construction joint. If the temperature of the mat falls below 190 °F before initial breakdown rolling, remove and replace the mat at no additional cost to the Department.

If placing the uppermost leveling and top course, place the longitudinal joint to coincide with the planned painted lane lines.

If the temperature of the mat falls below 170 °F before placing the adjacent mat, apply bond coat to the vertical edge of the mat.

If constructing the lanes with at least two pavers in echelon, match the depth of loose HMA from each paver at the longitudinal joints.

Transition the new mat to existing surfaces at the beginning and end of resurfacing sections and at intersections unless using butt joints. Transition the new mat to existing surfaces at a rate of 1 inch over 35 feet. Construct transitions on a cured bond coat applied at a rate of 0.10 gallons per square yard. After compaction, spray with bond coat, sand, and roll the first 3 feet of the joint and 1 foot of the existing surface.

2. Joints in HMA Pavement.

- a. **Transverse Construction Joint.** If constructing a transverse construction joint, stop the paver and lift the screed before material falls below the auger shaft. Remove the paver and roll through the planned joint location. Cut a transverse vertical joint and remove excess HMA.

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Place burlap, canvas, or paper as a bond breaker ahead of, and against the vertical face. Place HMA against the bond breaker and taper from the new mat to the existing surface. Extend the temporary taper 5 feet for each inch of mat thickness, or as directed by the Engineer. Compact and cool the temporary taper before allowing traffic on the new surface. Remove the temporary taper before resuming paving.

- b. **Vertical Longitudinal Joint.** When opening to traffic, plan the work to resurface adjacent lanes to within one load of the same ending point at the completion of paving operations each day. Construct a vertical joint to conform to the pavement cross section.

When compacting an unsupported (unconfined) edge of the mat, keep the roller from 3 inches to 6 inches inside the unsupported edge on the first pass; ensure the roller overhangs the unsupported edge by 3 inches to 6 inches on the second pass.

When placing HMA in a lane adjoining a previously placed lane, place the mixture so that the strike off shoe will produce an edge that is adjacent to or minimally overlaps the adjoining course. Compact the longitudinal joint by rolling from the hot side, keeping the edge of the roller approximately 6 inches to 8 inches inside the cold joint for the first pass. For the second pass of the roller, compact the joint from the hot side while overlapping the cold side by 6 inches to 8 inches.

- c. **Tapered Overlapping Longitudinal Joint.** The Engineer will allow a tapered overlapping longitudinal joint in lieu of a longitudinal vertical joint.

If using tapered overlapping longitudinal joints, the Engineer will not require resurfacing lanes within one load of the same point-of-ending at the completion of paving operations each day. Pave adjacent lanes within 24 hours, unless delayed by inclement weather or approved by the Engineer.

Construct the tapered overlapping longitudinal joint by tapering the HMA mat at a slope no greater than 1:12. Extend the tapered portion beyond the normal lane width.

Place a ½-inch to 1-inch notch at the top of the taper on paving courses.

Provide a uniform slope by constructing the tapered portion of the mat using a Department-approved strike-off device that will not restrict the main screed.

Apply bond coat to the surface of the taper before placing the adjacent lane.

3. **Placing HMA Shoulders.** Use a self-propelled mechanical paver or spreader to place HMA shoulders.

If placing the top course on new shoulders, or placing leveling, or top course on existing HMA shoulders at least 8 feet wide, place the mix using a paver with an automatically controlled and activated screed and strike-off assembly and corresponding grade referencing equipment. Use grade-referencing equipment, as directed by the Engineer.

Stop shoulder paving at crossroad approaches, auxiliary lanes, commercial driveways, and ramps. Do not pave through these areas.

4. **Placing HMA Approaches.** Place HMA on driveway or crossroad approach foundations, approved by the Engineer.

Place approaches in layers no greater than the application rate. Do not stop mainline paving of lanes adjacent to the approach to pave the HMA approach.

- G. **Rolling.** Compact each layer of HMA in accordance with the contract and free of roller marks.

Keep the surface of the steel roller wheels moist during rolling.

- H. **Smoothness Requirements.** After final rolling, the Engineer may test the surface longitudinally and transversely using a 10-foot straightedge at selected locations in accordance with MTM 722. Construct the surface and correct variations, at no additional cost to the Department, to the tolerances specified in this subsection.

1. **Base Course.** Construct lower layers of base courses to a tolerance of $\frac{3}{4}$ inch, and final layers of base courses to a tolerance of $\frac{3}{8}$ inch.
2. **Leveling and Top Course.** For multiple course construction, construct lower courses to a tolerance of $\frac{1}{4}$ inch, and top courses to a tolerance of $\frac{1}{8}$ inch.

Construct single courses to a tolerance of $\frac{1}{4}$ inch.

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I. Weather and Seasonal Limitations.

1. HMA Weather Limitations. Except as limited by subsection 501.03.1.2, place HMA in accordance with the following restrictions:

- a. Do not place HMA or apply bond coat when moisture on the existing surface prevents curing;
- b. Do not place HMA unless the temperature of the surface being paved is at least 35 °F and there is no frost on or in the grade or on the surface being paved, unless otherwise approved by the Engineer in writing;
- c. Place only HMA courses that are greater than 200 pounds per square yard if the temperature of the surface being paved is greater than 35 °F;
- d. Place only HMA courses that are greater than 120 pounds per square yard if the temperature of the surface being paved is at least 40 °F; and
- e. Place any HMA course if the temperature of the surface being paved is at least 50 °F

2. HMA Seasonal Limitations. Unless otherwise approved by the Engineer in writing, place HMA in accordance with subsection 501.03.1.1 and the following seasonal limitations.

- a. From June 1 to October 15 for the Upper Peninsula;
- b. From May 15 to November 1 for the Lower Peninsula, north of M-46; and
- c. From May 5 to November 15 for the Lower Peninsula, south of M-46.

J. Protection of Structures. Protect bridges, curbs, gutters, driveways, sidewalks, barriers, and other appurtenances to prevent surfaces from becoming discolored during application of bond coat or HMA to the road surface. Remove material from appurtenances, as directed by the Engineer, at no additional cost to the Department.

K. Aggregate Shoulders. On resurfacing projects, scarify existing aggregate shoulder surfaces before placing new aggregate material.

Maintain the shoulder for vehicles to pass the construction equipment. If Contractor operations or traffic disturbs the area between the pavement and the right-of-way line, restore the area to a condition approved by the Engineer at no additional cost to the Department.

L. Monument Boxes. Place or adjust monument boxes in accordance with section 821.

M. Quality Control (QC) Plan. Prepare and implement a quality control (QC) plan for HMA, in accordance with the HMA Production Manual.

Make adjustments in process controls to prevent production of non-conforming material in lieu of accepting payment at a reduced price. The Department will not allow continual production of non-conforming material at a reduced price in lieu of making adjustments.

The Engineer will not perform sampling or testing for quality control or assist in controlling the HMA production and placement operations.

N. HMA Mix Acceptance. The Engineer will inspect field-placed material, perform QA sampling and testing, and monitor Contractor adherence to the HMA-QC Plan.

1. **HMA Field-Placed Inspection.** The Engineer will perform inspection acceptance of HMA. The Department will inspect the base and leveling courses within 18 hours and the top course within 36 hours of placement. The Engineer will accept the pavement within these timeframes unless corrective action is required. If the Engineer determines that corrective action is required, inspection acceptance and paving of overlying courses will not occur until after the Contractor completes corrective action and the Engineer has determined that the pavement is in conformance with the contract.

The Engineer will determine the need for corrective action based on the acceptance factors specified in Table 501-5. Corrective action may include remedial treatment, including crack or surface sealing, or replacement.

Submit an action plan to the Engineer that addresses all acceptance factors that resulted in the need for corrective action. Complete all corrective action required to repair or replace unacceptable work at no additional cost to the Department.

If the Engineer and the Contractor agree, the Department may make a contract adjustment of no greater than 100 percent of the bid price for corrective action.

The Department will not grant time extensions for repair work to meet the inspection acceptance requirements specified in subsection 501.04.N.1.

The Engineer will determine the area subject to corrective action, for removal and replacement of top courses, as the longitudinal extent of corrective action multiplied by the width of the paving course affected.

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The Department will accept HMA subject to corrective action as follows:

- a. HMA placed for corrective action involving full removal and replacement will be accepted in accordance with the contract.
 - b. The area requiring corrective action other than full removal and replacement will not be measured for incentive payment.
 - c. If more than 10 percent of the area of a subplot requires corrective action, the subplot will not be measured for incentive payment.
2. **HMA Testing Acceptance.** The Engineer will accept HMA based on visual inspection, small tonnage, or QA sampling and testing acceptance criteria. The Engineer will notify the Contractor before conducting QA sampling to allow the Contractor to witness the sampling, but not in a manner that will allow alteration of production in anticipation of sampling. The Engineer will conduct QA sampling in accordance with MTM 313.
- a. **Visual Inspection Acceptance Criteria.** The Engineer may accept quantities less than 500 tons, of any individual mixture, in accordance with the Materials Quality Assurance Manual.
 - b. **Small Tonnage Acceptance Criteria.** If the total tonnage of a specific mix does not exceed 5,000 tons, the Engineer will perform QA sampling and testing in accordance with the contract.
 - c. **QA Sampling and Testing Acceptance Criteria.** If the total tonnage of a specific mix is greater than 5,000 tons, the Engineer will perform QA sampling and testing in accordance with the contract.
- O. **Asphalt Binder Acceptance.** The Department will accept asphalt binder in accordance with Department procedures.

Table 501-5 HMA Acceptance Factors and Corrective Action				
Acceptance Factors (a)	Length	Extent (b)	Severity	Corrective Action (c)
Segregation	—	>215 ft ² / 328 ft LL	Heavy (d)	Replace
Rutting	—	>32 ft	>¼ in average depth over the length of occurrence	Replace
Flushing	—	>108 ft ² / 328 ft LL	High (e)	Replace
Edge of Paved Shoulder	>33 ft	visible ledges	>3 in	Trim
Crack (g)	any	any	all	Seal (f)
Note: LL = lane length. a. Acceptance factors apply to all courses except flushing, which applies to the top course only. b. Extent is calculated by summing locations within the length required. c. The appropriate corrective action is dependent on the extent and severity of the factor, and on the intended service life of the pavement. d. Segregation severity will be determined in accordance with MTM 326 . If segregation thresholds are met twice on a paving course, the Contractor may be required to use a Material Transfer Device for the remaining paving for that course at no additional cost to the Department. e. Flushing severe enough to significantly effect surface friction (Friction Number <35). f. Other corrective action may be required as crack frequency increases. g. A reflective crack determined by the Engineer to be caused by an underlying condition.				

501.04. Measurement and Payment.

Pay Item	Pay Unit
HMA, 5 E _____	Ton
HMA, 4 E _____	Ton
HMA, 3 E _____	Ton
HMA, 2 E _____	Ton
HMA, LVSP _____	Ton
HMA, (type), High Stress _____	Ton
HMA Approach _____	Ton
HMA Approach, High Stress _____	Ton
Pavt for Butt Joints, Rem _____	Square Yard
Edge Trimming _____	Foot
Cold Milling HMA Surface _____	Square Yard, Ton
HMA Surface, Rem _____	Square Yard
HMA Patch, Rem _____	Square Yard
Joint and Crack, Cleanout _____	Foot
Hand Patching _____	Ton
Pavt, Cleaning _____	Lump Sum
Pavt Joint and Crack Repr, Det _____	Foot

501.04

A. **HMA, (type), High Stress.** The Department may pay for HMA, (type), High Stress for up to 150 feet outside the limits shown on the plans to ensure the Contractor has time to transition to the high stress HMA. The Department will pay for high stress HMA placed outside the 150-foot limit as other HMA mix pay items.

B. **Pavement for Butt Joints, Removal.** The unit price for Pavt for Butt Joints, Rem includes the cost of removing and disposing of concrete or HMA materials.

C. **Edge Trimming.** The Engineer will measure Edge Trimming along the cut edge. The unit price for Edge Trimming includes the cost of cutting, removing, and disposing of excess HMA material.

D. **Cold Milling HMA Surface.** The unit price for Cold Milling HMA Surface includes the cost of removing, loading, hauling, weighing and disposing of the cold milled material, and cleaning the cold milled pavement. If paid by the ton for cold-milled HMA, deposit the cold milled material directly from the cold milling machine into the hauling units and weigh on a scale meeting the requirements of subsection 109.01.G before placement in a stockpile or a disposal area.

The Engineer will not weigh or pay for material picked up by cleaning after cold milling.

E. **Pavement, Cleaning.** The Engineer will measure Pavt, Cleaning as a unit, including paved shoulders, approaches, and widened areas. The unit price for Pavt, Cleaning includes the cost of cleaning the foundation, joints, and cracks, and sweeping shoulders, base courses, and leveling courses.

If the Engineer directs additional hand or mechanical methods to clean the pavement, the Department will pay for this work as Joint and Crack, Cleanout if the contract documents include the pay item. If the contract documents do not include a pay item for joint and crack cleanout, the Department will pay for additional hand or mechanical work as extra work, in accordance with subsection 109.07.

F. **Joint and Crack, Cleanout.** The Engineer will measure Joint and Crack, Cleanout along the cleaned joint and crack. If using compressed air does not completely clean out the joint or crack, and the Engineer directs the use of hand or mechanical methods to remove loose material, then the Department will pay for this as extra work, in accordance with subsection 103.02.

G. **Hand Patching.** The unit price for Hand Patching includes the cost of placing HMA, by hand or other methods, and compacting the material.

H. Removing HMA Surface. The Engineer will measure, and the Department will pay for removing HMA surface, no greater than 12 inches thick, overlying material to remain in place, as **HMA Surface, Rem**. The unit price for **HMA Surface, Rem** includes the cost of edge cutting to establish a neat line, as required, and removal and disposal of the HMA material.

The Engineer will measure and the Department will pay for removing HMA surface, greater than 12 inches thick, overlying material to remain in place, as **Pavt, Rem** in accordance with subsection 204.04.

I. Pavement Joint and Crack Repair. The Engineer will measure **Pavt Joint and Crack Repr**, of the detail required, along the joint and crack. If the pavement joint and crack repair exceeds 30 inches in width, the Engineer will measure each 30-inch wide segment, or portion thereof, separately for payment. The Department will pay for the HMA material used to fill the joints, after removal of objectionable material, as **Hand Patching**.

J. HMA. The Engineer will measure, and the Department will pay for, **HMA** of the mix specified based on the weight placed, as supported by weigh tickets. The Engineer will adjust the unit price for HMA, of the mix specified, in accordance with the contract.

902.01

Section 902. AGGREGATES

902.01. General Requirements. The Department may re-inspect and retest aggregates regardless of inspection at the producing plant. Provide safe access to the material for sampling from haul units or stockpiles.

Do not use spent metal casting foundry sand, unless the contract expressly allows for its use.

Do not contaminate aggregate during loading or measurement. Transport and place aggregate without loss of material.

902.02. Testing. Test aggregate materials in accordance with the following:

Material	Test
Wire Cloth and Sieves	AASHTO M 92
Materials Finer than 75 mm (No. 200) Sieve in	
Mineral Aggregates by Washing	AASHTO T 11
Specific Gravity and Absorption of Coarse Aggregate ..	AASHTO T 85
Specific Gravity and Absorption of Fine Aggregates	AASHTO T 84
Sieve Analysis of Fine and Coarse Aggregate	AASHTO T 27
Sampling and Testing Fly Ash	ASTM C 311
Sand Equivalent of Fine Aggregate	ASTM D 2419
Flat Particles, Elongated Particles, or Flat and	
Elongated Particles in Coarse Aggregate	ASTM D 4791
Organic Impurities in Fine Aggregate	AASHTO T 21
Sieve Analysis of Mineral Filler	AASHTO T 37
Mortar Strength	AASHTO T 71
Particle Size Analysis	AASHTO T 88
Plastic fines in Graded Aggregates and	
Soils by Use of the Sand Equivalent Test	AASHTO T 167
Uncompacted Void Content of Fine Aggregate	AASHTO T 304
Water Asphalt Preferential Test	<u>MTM 101</u>
LA Abrasion Resistance of Aggregate	<u>MTM 102</u>
Insoluble Residue in Carbonate Aggregate	<u>MTM 103</u>
Sampling Aggregates	<u>MTM 107</u>
Loss by Washing	<u>MTM 108</u>
Sieve Analysis of Aggregate	<u>MTM 109</u>
Deleterious and Objectionable Particles	<u>MTM 110</u>
Aggregate Wear Index	<u>MTM 112</u>
Selection and Preparation of Coarse Aggregate	
Samples for Freeze-Thaw Testing	<u>MTM 113</u>

Making Concrete Specimens for Freeze-Thaw	
Testing on Concrete Coarse Aggregate	<u>MTM 114</u>
Freeze-Thaw Testing of Coarse Aggregate	<u>MTM 115</u>
Crushed Particles in Aggregates	<u>MTM 117</u>
Angularity Index of Fine Aggregate	<u>MTM 118</u>
Sampling Open-Graded Drainage Course	
Compacted in Place	<u>MTM 119</u>
Dry Unit Weight (LM) of Coarse Aggregate.....	<u>MTM 123</u>
Determining Specific Gravity and Absorption of	
Coarse Aggregates	<u>MTM 320</u>
Determining Specific Gravity and Absorption of	
Coarse Aggregates	<u>MTM 321</u>

A. **Terminology.** The Department uses the following terminology in the testing and acceptance of aggregates:

Natural Aggregates. Aggregates originated from stone quarries, gravel, sand or igneous/ metamorphic rock deposits.

Slag Aggregates. By-products formed in the production of iron, copper, and steel.

Iron Blast Furnace Slag. A synthetic nonmetallic by-product simultaneously produced with pig iron in a blast furnace that primarily consists of a fused mixture of oxides of silica, alumina, calcium, and magnesia.

Reverberatory Furnace Slag. A nonmetallic by-product of refined copper ore.

Steel Furnace Slag. A synthetic by-product of basic oxygen, electric or open-hearth steel furnaces that primarily consists of a fused mixture of oxides of calcium, silica, iron, alumina, and magnesia.

Crushed Concrete Aggregate. Crushed portland cement concrete.

Salvaged Aggregate. Dense-graded aggregate saved or manufactured from Department project sources that may consist of natural aggregate, blast furnace slag, crushed concrete, or reclaimed asphalt pavement with particle sizes no greater than 2 inches and no visible organic or foreign matter.

Manufactured Fine Aggregate. One hundred percent crushed rock, gravel, iron blast furnace slag, reverberatory furnace slag, steel furnace slag, or portland cement concrete.

902.02

Natural Sand 2NS and 2MS. Fine, clean, hard, durable, uncoated particles of sand free from clay lumps, and soft or flaky granular material resulting from the natural disintegration of rock, and used in concrete mixtures, mortar mixtures, and intrusion grout for pre-placed aggregate concrete.

Stone Sand 2SS. Sand manufactured from stone sources. These stone sources must meet the physical requirements for coarse aggregate 6A prior to crushing. The Engineer will only allow stone sand in concrete base course or structural concrete not exposed to vehicular traffic.

Soft Particles. Structurally weak particles or particles experiencing environmental deterioration, including shale, siltstone, friable sandstone, ochre, coal, and clay-ironstone.

Crushed Particles. Particles with at least one fractured face. The contract will specify the number of fractured faces based on required use. Unless otherwise specified, one fractured face is considered a crushed particle.

Base Fineness Modulus. The average fineness modulus typical of the source for a specific fine aggregate.

Cobblestones (Cobbles). Rock fragments, usually rounded or semi-rounded, with an average dimension between 3 inches and 10 inches.

902.03. Coarse Aggregates for Portland Cement Concrete. For coarse aggregates for portland cement concrete, use Michigan Class 4AA, 6AAA, 6AA, 6A, 17A, and 26A coarse aggregate produced from natural aggregate, iron blast furnace slag, or reverberatory furnace slag sources.

The Contractor may produce Michigan Class 6A, 17A and 26A from crushed portland cement concrete for uses specified in this subsection.

Ensure the bulk dry specific gravity falls within the limits established by freeze-thaw testing.

Provide coarse aggregates for portland cement concrete in accordance with Table 902-1, Table 902-2, and this subsection.

A. **Slag Coarse Aggregate.** Use slag coarse aggregate consisting of iron blast furnace slag or reverberatory furnace slag with a dry (loose measure) unit weight of at least 70 pounds per cubic foot in accordance with MTM 123.

B. Crushed Concrete Coarse Aggregate. Use Department-owned concrete on the project to produce crushed concrete coarse aggregate. The Contractor may use crushed concrete coarse aggregate in the following concrete mixtures: curb and gutter, valley gutter, sidewalk, concrete barriers, driveways, temporary pavement, interchange ramps with a commercial ADT less than 250, and concrete shoulders.

Do not use crushed concrete coarse aggregate in the following: mainline pavements or ramps with a commercial ADT greater than or equal to 250, concrete base course, bridges, box or slab culverts, headwalls, retaining walls, pre-stressed concrete, or other heavily reinforced concrete.

Avoid contamination with non-concrete materials, including joint sealants, HMA patching, and base layer aggregate or soil, when processing crushed concrete coarse aggregate. Limit contamination particles retained on the $\frac{3}{8}$ -inch sieve to no greater than 3.0 percent, based on a particle count of the total retained $\frac{3}{8}$ -inch aggregate particles. The Engineer will reject any aggregate stockpile contaminated with building brick, wood, or plaster. Steel reinforcement pieces may remain in the stockpile if they can pass the maximum grading sieve size without aid. Ensure the fine aggregate portion of the gradation does not exceed a liquid limit of 25.0 percent or a plasticity index of 4.0.

The Engineer will test the freeze-thaw durability of crushed concrete coarse aggregate for each project. After the Department's central laboratory receives the aggregate samples, each test requires at least three months for testing.

Crush concrete ensuring it maintains uniform aggregate properties with no apparent segregation. The specific gravity must not vary more than ± 0.05 nor the absorption by more than ± 0.40 . Separate crushed concrete aggregate according to the original coarse aggregate type, except in the following situations:

1. If the weighed quantities of each aggregate type retained on the No. 4 sieve do not differ from the average quantities obtained from at least three representative samples by more than 10 percent; or
2. If using aggregate produced from concrete pavement with only one type of aggregate, but repaired with concrete patches with a different aggregate type.

902.03

C. Aggregates for Optimized Gradation.

1. Coarse Aggregate Requirements.

- a. Coarse aggregate includes all aggregate particles greater than or retained on the ½-inch sieve.
- b. The physical requirements for coarse aggregate are as specified in Table 902-2 for Class 6AAA and the following:
 - i. Maximum 24 hour soak absorption of 2.50 percent;
 - ii. Maximum freeze-thaw dilation of 0.040 percent per 100 freeze-thaw cycle;
 - iii. Maximum flat and elongated particles of 15.0 percent as measured on the greater than or retained on the ¾-inch sieve using a 3:1 aspect ratio (ASTM D 4791); and
 - iv. Maximum Loss by Washing per MTM 108 of 2.0 percent for materials produced entirely by crushing rock, boulders, cobbles, slag or concrete; otherwise 1.0 percent.

2. Intermediate Aggregate Requirements.

- a. Intermediate aggregate includes all aggregate particles passing the ½-inch sieve through those retained on the No. 4 sieve.
- b. The physical requirements for intermediate aggregate are as specified in Table 902-2 for Class 6AAA and the following:
 - i. Maximum freeze-thaw dilation of 0.067 percent per 100 freeze-thaw cycle;
 - ii. Maximum sum of soft and chert particles of 4.0 percent by weight (MTM 110); and
 - iii. Maximum Loss by Washing per MTM 108 of 2.0 percent.

3. Fine Aggregate Requirements.

- a. Fine aggregate includes all aggregates particles passing the No. 4 sieve.
- b. The fine aggregate must meet the requirements of subsection 902.08.

902.04. Chip Seal Aggregates. For chip seal, use 34CS aggregate with a maximum moisture content of 4 percent, calculated in accordance with section 109 at the time of placement, and in accordance with Table 902-7, and Table 902-8.

902.05. Dense-Graded Aggregates for Base Course, Surface Course, Shoulders, Approaches and Patching. When necessary, combine fine aggregate with natural aggregate, iron blast furnace slag, reverberatory furnace slag, or crushed concrete to produce Michigan

Class 21AA, 21A, 22A, and 23A dense-graded aggregates in accordance with Table 902-1, Table 902-2, and this subsection.

Ensure dense-graded aggregate produced by crushing portland cement concrete does not contain more than 5.0 percent building rubble or hot mix asphalt by particle count. The Department defines building rubble as building brick, wood, plaster, or other material. The Engineer will allow pieces of steel reinforcement capable of passing through the maximum grading sieve size without aid.

Do not use Class 21AA, 21A and 22A dense-graded aggregate produced from crushing portland cement concrete to construct an aggregate base or an aggregate separation layer when the dense-graded layer drains into an underdrain, unless at least one of the following conditions apply:

- A. A vertical layer of at least 12 inches of granular Class I, II, IIA, or IIAA exists between the dense-graded aggregate layer and an underdrain; or
- B. A geotextile liner or blocking membrane, that will be a barrier to leachate, placed between the crushed concrete and the underdrain.

Only produce Class 23A dense-graded aggregate from steel furnace slag for use as an unbound aggregate surface course or as an unbound aggregate shoulder.

902.06. Open-Graded Aggregates for Earthwork, Open-Graded Drainage Courses and Underdrains. Use Michigan Class 4G, 34G, and 34R open-graded aggregates produced from natural aggregate, iron blast furnace slag, reverberatory furnace slag, or crushed concrete in accordance with Table 902-1 and Table 902-2.

Ensure open-graded aggregate 4G produced by crushing portland cement concrete does not contain more than 5.0 percent building rubble or hot mix asphalt by particle count. The Department defines building rubble as building brick, wood, plaster, or other material. The Engineer will allow pieces of steel reinforcement capable of passing through the maximum grading sieve size without aid.

Do not use open-graded aggregate 34G or 34R produced from portland cement concrete.

902.07. Granular Materials for Fill and Subbase. Use granular materials consisting of sand, gravel, crushed stone, iron blast furnace slag, reverberatory furnace slag or a blend of aggregates in accordance with Table 902-3 and this subsection.

The Contractor may make the following substitutions:

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- A. Class I or Class IIAA material for Class II material;
- B. Class I, Class II, Class IIA, Class IIAA or Class IIIA material for Class III material; and
- C. Class I material for Class IIAA material.

Do not use material with cementitious properties or with permeability characteristics that do not meet design parameters for subbase.

The Engineer will only allow the use of granular material produced from crushed portland cement concrete for swamp backfill, embankment (except the top 3 feet below subgrade) and as trench backfill for non-metallic culvert and sewer pipes without associated underdrains.

The Engineer may allow the placement of granular material produced from steel furnace slag below the top 3 feet of the embankment and fill.

902.08. Fine Aggregates for Portland Cement Concrete and Mortar. Ensure that, when tested for organic impurities in accordance with AASHTO T 21, the aggregate does not produce a color darker than Plate 3 (light brown). The Engineer may approve the use of fine aggregate that fails the test for organic impurities based on one of the following:

- A. The discoloration resulted from small quantities of coal, lignite, or similar discrete particles, or
- B. The tested concrete develops a relative seven-day strength of at least 95 percent in accordance with AASHTO T 71.

Uniformly grade the aggregate from coarse to fine in accordance with Table 902-4. Fine aggregate 2NS, 2SS, and 2MS must meet fineness modulus requirements in Table 902-4.

Do not use crushed portland cement concrete fine aggregate in new concrete mixtures.

902.09. Aggregate General Requirements for HMA Mixtures. Ensure the HMA mixture consists of aggregate materials meeting the requirements of Table 902-5 and Table 902-6 for the mix number and type required.

- A. **Coarse Aggregates.** For HMA mixtures, use natural aggregate, iron blast furnace slag, reverberatory furnace slag, steel furnace slag, or crushed concrete as coarse aggregate.
- B. **Fine Aggregates.** For HMA mixtures, use natural aggregate, iron blast furnace slag, reverberatory furnace slag, steel furnace slag, manufactured fine aggregate, or a uniformly graded blend as fine aggregate. Ensure fine aggregates are clean, hard, durable, uncoated,

and free of clay lumps, organic matter, soft or flakey material and other foreign matter.

902.10. Surface Treatment Aggregates.

A. Paver-Placed Surface Seal. For paver-placed surface seal, use aggregate 27SS or 30SS consisting of material meeting the requirements of subsection 902.09.B and in accordance with Table 902-7 and Table 902-8.

B. Micro-Surfacing. For micro-surfacing, use 2FA and 3FA aggregates consisting of crushed material from a quarried stone, natural gravel, slag source, or a blend in accordance with Table 902-7 and Table 902-8.

C. Slurry Seal. For slurry seal, use 2FA aggregate consisting of crushed material from a quarried stone, natural gravel, slag source, or a blend in accordance with Table 902-7 and Table 902-8.

902.11. Mineral Filler for HMA Mixtures. For HMA mixtures, use dry, 3MF mineral filler consisting of limestone dust, dolomite dust, fly ash collected by an electrostatic precipitation method, slag, or hydrated lime with 100 percent passing the No. 30 sieve and 75 percent to 100 percent passing the No. 200 sieve. Mineral filler must be from a Department-approved source or must be tested on a per project basis. The free carbon content of the fly ash sample must not exceed 12 percent by weight as measured by the loss on ignition test in accordance with ASTM C 311.

Table 902-1 Grading Requirements for Coarse Aggregates, Dense-Graded Aggregates, and Open-Graded Aggregates													
Material Type	Class	Item of Work by Section Number (Sequential)	Sieve Analysis (MTM 109) Total Percent Passing (a)							No. 8	No. 30	Loss by Washing (MTM 108) % Passing	
			2½ in	2 in	1½ in	1 in	¾ in	½ in	¾ in				
Coarse Aggregates	4 AA (b)	602	100	90-100	40-60	—	0-12	—	—	—	—	≤2.0	
	6 AAA (b)	602	—	—	100	90-100	60-85	30-60	—	0-8	—	≤1.0 (c)	
	6 AA (b)	601, 602, 706, 708, 806	—	—	100	95-100	—	30-60	—	0-8	—	≤1.0 (c)	
	6 A	205, 401, 402, 601, 602, 603, 706, 806	—	—	100	95-100	—	30-60	—	0-8	—	≤1.0 (c)	
	17 A	401, 406, 701, 706, 708	—	—	—	100	90-100	50-75	—	0-8	—	≤1.0 (c)	
	25 A	—	—	—	—	—	100	95-100	60-90	5-30	0-12	≤3.0	
Dense-Graded Aggregates	26 A	706, 712	—	—	—	—	100	95-100	60-90	5-30	0-12	≤3.0	
	29 A	—	—	—	—	—	—	100	90-100	10-30	0-10	≤3.0	
	21 AA	302, 304, 305, 306, 307	—	—	100	85-100	—	50-75	—	—	20-45	4-8 (d,e)	
	21 A	302, 305, 306, 307	—	—	100	85-100	—	50-75	—	—	20-45	4-8 (d,e)	
	22 A	302, 305, 306, 307	—	—	—	100	90-100	—	65-85	—	30-50	4-8 (d, e, f)	
	23 A	306, 307	—	—	—	100	—	—	60-85	—	25-60	9-16 (e)	
Open-Graded Aggregates	4 G (g)	303	—	—	—	—	—	—	—	—	—	—	
	34 R	401, 404	—	—	—	—	—	100	90-100	—	0-5	≤3.0	
	34 G	404	—	—	—	—	—	100	95-100	—	0-5	≤3.0	
a. Based on dry weights.													
b. Class 6AAA will be used exclusively for all mainline and ramp concrete pavement when the directional commercial ADT is greater than or equal to 5,000 vehicles per day.													
c. Loss by Washing will not exceed 2.0 percent for material produced entirely by crushing rock, boulders, cobbles, slag, or concrete.													
d. When used for aggregate base courses, surface courses, shoulders and approaches and the material is produced entirely by crushing rock, boulders, cobbles, slag, or concrete, the maximum limit for Loss by Washing must not exceed 10 percent.													
e. The limits for Loss by Washing of dense-graded aggregates are significant to the nearest whole percent.													
f. For aggregates produced from sources located in Berrien County, the Loss by Washing must not exceed 8 percent and the sum of Loss by Washing and shale particles must not exceed 10 percent.													
g. Reference contract documents.													

a. Based on dry weights.

b. Class 6AAA will be used exclusively for all mainline and ramp concrete pavement when the directional commercial ADT is greater than or equal to 5,000 vehicles per day.

c. Loss by Washing will not exceed 2.0 percent for material produced entirely by crushing rock, boulders, cobbles, slag, or concrete.

d. When used for aggregate base courses, surface courses, shoulders and approaches and the material is produced entirely by crushing rock, boulders, cobbles, slag, or concrete, the maximum limit for Loss by Washing must not exceed 10 percent.

e. The limits for Loss by Washing of dense-graded aggregates are significant to the nearest whole percent.

f. For aggregates produced from sources located in Berrien County, the Loss by Washing must not exceed 8 percent and the sum of Loss by Washing and shale particles must not exceed 10 percent.

g. Reference contract documents.

Material	Series/ Class	Gravel, Stone, and Crushed Concrete					Slag (a)		All Aggregates Flat and Elongated Particles, ratio % max (ASTM D 4791)	
		Crushed Material, % min (MTM 117)	Loss, % max, Los Angeles Abrasion (MTM 102)	Soft Particles, % max (MTM 110)	Chert, % max (MTM 110)	Sum of Soft Particles and Chert, % max (MTM 110)	Freeze-Thaw Dilatation, % per 100 cycle max (MTM 115) (d)	Sum of Coke and Coal Particles, % max (MTM 110)		Freeze-Thaw Dilatation, % per 100 cycles max (MTM 115) (d)
Coarse Aggregates (n)	4 AA (b)	—	40	—	—	2.0 (c)	0.020	1.0	0.020	3:1–15.0 (l)
	6 AAA	—	40	2.0 (e)	2.5	4.0	0.040 (f)	1.0	0.040 (f)	—
	6 AA (g)	—	40	2.0 (e)	—	4.0	0.067 (h)	1.0	0.067	—
	6 A (g)	—	40	3.0 (e)	7.0	9.0	0.067	1.0	0.067	—
	17 A (g)	—	40	3.5 (e)	8.0	10.0	0.067	1.0	0.067	—
	25 A	95	45	8.0 (i)	—	8.0	—	1.0	—	3:1–20.0 (m)
Dense- Graded Aggregates (j)	26 A (g)	—	40	2.0 (e)	—	4.0	0.067	1.0	0.067	—
	29 A	95	45	8.0 (i)	—	8.0	—	1.0	—	3:1–20.0 (m)
	21 AA	95	50	—	—	—	—	—	—	—
	21 A	25	50	—	—	—	—	—	—	—
	22 A	25	50	—	—	—	—	—	—	—
	23 A	25	50	—	—	—	—	—	—	—
Open- Graded Aggregates	4 G	95	45 (k)	—	—	—	—	—	—	—
	34 R	≥20	45 (k)	—	—	—	—	—	—	—
	34 G	100	45 (k)	—	—	—	—	—	—	—

Notes for Table 902-2:

- a. Iron blast furnace and reverberatory furnace slag must contain no free (unhydrated) lime.
- b. 2.50 percent maximum 24 hour soak absorption based on oven dry 6 series aggregate.
- c. 1.0% maximum for particles retained on the 1 inch sieve.
- d. If the bulk dry specific gravity is more than 0.04 less than the bulk dry specific gravity of the most recently tested freeze-thaw sample, the aggregate will be considered to have changed characteristics and be required to have a new freeze-thaw test conducted prior to use on Department projects.
- e. Clay-ironstone particles must not exceed 1.0 percent for 6AAA, 6AA and 26A, and 2.0 percent for 6A and 17A. Clay-ironstone particles are also included in the percentage of soft particles for these aggregates.
- f. Maximum freeze-thaw dilation is 0.067 when the directional commercial ADT is less than 5000 vehicles per day.
- g. Except for pre-stressed beams, the sum of soft and chert particles may be up to 3.0 percent higher than the values determined from the sample tested for freeze-thaw durability. However, under no circumstances will the deleterious particle percentages exceed the specification limits in Table 902-2. In addition, a source may be restricted to a minimum percent crushed not to exceed 15 percent less than the percent crushed in the freeze-thaw sample. When the freeze-thaw dilation is between 0.040 and 0.067 percent per 100 cycles more restrictive limits will be applied.
- h. Maximum dilation of 0.010 for pre-stressed concrete beams.
- i. Friable sandstone is included in the soft particle determination for chip seal aggregates.
- j. Quarried carbonate (limestone or dolomite) aggregate may not contain over 10 percent insoluble residue finer than No. 200 sieve when tested in accordance with MTM 103.
- k. If a blend of different aggregate sources, the abrasion value applies to each source.
- l. ASTM D 4791 Section 8.4 will be followed. The test will be performed on the material retained down to and including the 1 inch sieve.
- m. ASTM D 4791 Section 8.4 will be followed. The test will be performed on the material retained down to and including the No. 4 sieve.
- n. Grade P1M concrete requires an optimized aggregate gradation as specified in section 604. Use aggregates only from geologically natural sources.

Table 902-3
Grading Requirements for Granular Materials

Material	Sieve Analysis (MTM 109), Total % Passing (a)						Loss by Washing % Passing No. 200 (a), (b)	
	6 in	3 in	2 in	1 in	½ in	% in	No. 4	No. 10
Class I	—	—	100	—	45–85	—	20–85	5–30
Class II (c)	—	100	—	60–100	—	—	50–100	—
Class IIA (c)	—	100	—	60–100	—	—	50–100	—
Class IIAA	—	100	—	60–100	—	—	50–100	—
Class III	100	95–100	—	—	—	—	50–100	—
Class IIIA	—	—	—	—	—	100	50–100	—

a. Test results based on dry weights.
b. Use test method MTM 108 for Loss by Washing.
c. Except for use in granular blankets, Class IIA granular material may be substituted for Class II granular material for projects located in the following counties: Arenac, Bay, Genesee, Gladwin, Huron, Lapeer, Macomb, Midland, Monroe, Oakland, Saginaw, Sanilac, Shiawassee, St. Clair, Tuscola, and Wayne counties.

Table 902-4
Grading Requirements for Fine Aggregates

Material	Sieve Analysis (MTM 109), Total Percent Passing (a)						Loss by Washing % Passing No. 200 (a), (b)		Fineness Modulus Variation (c)
	¾ in	No. 4	No. 8	No. 16	No. 30	No. 50			
2NS	100	95–100	65–95	35–75	20–55	10–30	0–10	0–30	±0.20 (d)
2SS (e)	100	95–100	65–95	35–75	20–55	10–30	0–10	0–40	±0.20 (d)
2MS	—	100	95–100	—	—	15–40	0–10	0–30	±0.20 (d)

a. Test results based on dry weights.
b. Use test method MTM 108 for Loss by Washing.
c. Aggregate having a fineness modulus differing from the base fineness modulus of the source by the amount exceeding the maximum variation specified in the table, will be rejected. Use ASTM C 136.
d. The base fineness modulus will be supplied by the aggregate producer at the start of each construction season and be within the range of 2.50 to 3.35. The base FM, including the permissible variation, will be within the 2.50 to 3.35 range.
e. Quarried carbonate (limestone or dolomite) cannot be used for any application subject to vehicular traffic.

Table 902-5 Superpave Final Aggregate Blend Gradation Requirements						
Standard Sieve	Percent Passing Criteria (control points)					
	Mixture Number					
	5	4	3	2	LVSP (a)	
1½ in	—	—	—	100	—	—
1 in	—	—	100	90-100	—	—
¾ in	—	100	90-100	≤90	100	—
½ in	100	90-100	≤90	—	75-95	—
¾ in	90-100	≤90	—	—	60-90	—
No. 4	≤90	—	—	—	45-80	—
No. 8	32-67	28-58	23-49	19-45	30-65	—
No. 16	—	—	—	—	20-50	—
No. 30	—	—	—	—	15-40	—
No. 50	—	—	—	—	10-25	—
No. 100	—	—	—	—	5-15	—
No. 200	2.0-10.0	2.0-10.0	2.0-8.0	1.0-7.0	3-6	—
Sieve	Restricted Zone (b,c)					
No. 4	—	—	—	39.5	(d)	(d)
No. 8	47.2	39.1	34.6	26.8-30.8	(d)	(d)
No. 16	31.6-37.6	25.6-31.6	22.3-28.3	18.1-24.1	(d)	(d)
No. 30	23.5-27.5	19.1-23.1	16.7-20.7	13.6-17.6	(d)	(d)
No. 50	18.7	15.5	13.7	11.4	(d)	(d)

a. For LVSP, less than 50 percent of the material passing the No. 4 sieve may pass the No. 30 sieve.

b. The final gradation blend must pass between the control points established. The following conditions must be satisfied in order for the final gradation blend to enter the restricted zone.

c. Mixture types E03, E1, E3, E10, E30, and E50 may enter the restricted zone provided the final gradation blend enters from above the maximum density line.

d. Restricted zone does not apply to LVSP.

Table 902-6
Superpave Final Aggregate Blend Physical Requirements

Est. Traffic (million ESAL)	Mix Type	Fine Aggregate Angularity		% Sand Equivalent		Los Angeles Abrasion		% Soft Particles		% Flat and Elongated Particles	
		Minimum Criteria		Minimum Criteria		Minimum Criteria		Maximum Criteria (b)		Maximum Criteria (c)	
		Top & Leveling Courses	Base Course	Top & Leveling Courses	Base Course	Top & Leveling Courses	Base Course	Top & Leveling Courses	Base Course	Top & Leveling Courses	Base Course
<0.3	LVSP	—	—	40	40	45	45	10	10	—	—
<0.3	E03	—	—	40	40	45	45	10	10	—	—
>0.3—<1.0	E1	—	—	40	40	40	45	10	10	—	—
>1.0—<3	E3	40 (a)	40 (a)	40	40	35	40	5	5	10	10
>3—<10	E10	45	40	45	45	35	40	5	5	10	10
>10—<30	E30	45	40	45	45	35	35	3	4.5	10	10
>30—<100	E50	45	45	50	50	35	35	3	4.5	10	10

a. For an E3 mixture type that enters the restricted zone as defined in Table 902-5, the minimum is 43. If these criteria are satisfied, acceptance criteria and associated incentive/disincentive or pay adjustment tied to this gradation restricted zone requirement included in the contract, do not apply. Otherwise, final gradation blend must be outside of the restricted zone.

b. Soft particles maximum is the sum of the shale, siltstone, ochre, coal, clay-ironstone, and particles that are structurally weak or are non-durable in service.

c. Maximum by weight with a 1:5 aspect ratio.

Table 902-7
CPM Final Aggregate Blend Gradation Requirements

Material	Mechanical Analysis, Total Percent Passing									
	¾ in	½ in	¾ in	No. 4	No. 8	No. 16	No. 30	No. 50	No. 100	No. 200 (a)
	100	85-100	55-80	22-38	19-32	15-24	11-18	8-14	5-10	4-7 (b)
27SS	—	100	85-100	22-38	19-32	15-24	11-18	8-14	5-10	4-7 (b)
30SS	—	100	90-100	0-10	0-5	—	—	—	—	≤2.0
34CS	—	100	90-100	100	65-90	45-70	30-50	18-30	10-21	5-15 (b)
FA2	—	—	100	70-90	45-70	28-50	19-34	12-25	7-18	5-15 (b)
FA3	—	—	100	70-90	45-70	28-50	19-34	12-25	7-18	5-15 (b)

a. Includes mineral filler.

b. No. 200 limits are significant to the nearest whole percent.

Table 902-3 CPM Aggregate Blend Physical Requirements										
	Percent Crushed (Min)	Angularity Index (Min)	Uncompacted Void (Min)	Los Angeles Abrasion (% Loss Max)	AWI (min.)	Soft Particles (% Max)	Sand Equivalent (% Min)	Flat and Elongated (% Max)	Absorp. (% Max)	Mico- Deval (% Loss Max)
Material	MTM 117	MTM 118	AASHTO T 304	MTM 102	MTM 112	MTM 110	AASHTO T 176	ASTM D 4791	AASHTO T 85	AASHTO T 327
27SS (h)	90 (b)	—	40	35	260	5.0 (a)	45	25.0 (e)	3.0	18
30SS (h)	90 (b)	—	40	35	260	5.0 (a)	45	25.0 (e)	3.0	18
34CS	95	—	—	35 (c)	260 (d)	3.5 (a)	—	12.0 (e)	—	—
FA2	—	4.0 (f)	—	45	260	—	60 (g)	—	—	—
FA3	—	4.0	—	45	260	—	60	—	—	—
a. Sum of shale, siltstone, clay-ironstone, and structurally weak.										
b. Percent two-faced crushed.										
c. L. A. Abrasion maximum loss of 45 for blast furnace slag.										
d. Does not apply to shoulder area of the chip seal.										
e. For material retained on the No. 4 sieve, ensure the ratio between length to width, or length to thickness, or combination is no greater than 3:1.										
f. Angularity Index must exceed 2.0 for as least 50 percent of the blending sands for slurry seal applications.										
g. Does not apply to slurry seals.										
h. Must be 100% virgin aggregate.										

904.01

Section 904. ASPHALTIC MATERIALS

904.01. General Requirements. The certification program described in the Materials Quality Assurance Procedures Manual governs the asphalt binders in Table 904-2 and the emulsified asphalts in Table 904-4, Table 904-5, and Table 904-6. The Contractor may use materials listed in Table 904-2 through Table 904-6 on MDOT projects, if tested and approved for use in accordance with MDOT procedures.

The Engineer will notify the Contractor and the supplier to correct materials if test results for the requirements from Table 904-2, Table 904-3, Table 904-4, Table 904-5 and Table 904-6 deviate from the specified range.

Asphaltic materials testing will be in accordance with the specified ASTM, AASHTO or Department methods, as modified by this section.

904.02. Application Temperatures. Apply asphaltic materials at temperatures specified in Table 904-7.

904.03. Specific Requirements.

A. Asphalt Binder. Asphalt binder must be homogeneous, water-free, and must not foam when heated to the maximum temperature specified in Table 904-7 for the material required.

If using an anti-foaming agent, use a dimethyl polysiloxane type silicone material, preferably 1,000 centistoke viscosity grade, unless otherwise approved by the Engineer. Do not add amounts greater than 5 parts per million unless approved by the Engineer. Mechanically mix the asphalt binder after adding anti-foaming agent while in storage at the asphalt plant.

Asphalt cement must be prepared by refining crude petroleum with or without the addition of modifiers. Asphalt cement prepared with used motor oil is not allowed.

The Engineer will allow organic, virgin or recycled modifiers dissolved, dispersed, or reacted in asphalt cement to enhance performance.

Asphalt binder must be at least 99.0 percent soluble in accordance with AASHTO T 44 or ASTM D 5546.

This specification is not applicable for asphalt binders in which fibers or other discrete particles are larger than 250 micrometers in size.

B. Cut-Back Asphalt. Cutback asphalt must meet the requirements of Table 904-3 and this subsection.

Liquid asphalt must be homogeneous, must not foam when heated to the maximum required temperature and must be water-free unless otherwise required.

Caution: Use caution when heating cut-back asphalt, especially RC and MC asphaltic products containing naphtha and kerosene cutback asphalt, since the temperatures for use are near or above the flash points. If using heated cutbacks, keep open flames away from pugmill enclosures, tank car domes, distributor tank openings, and storage tank openings.

C. Emulsified Asphalt. Emulsified asphalt must meet the requirements of either Table 904-4, Table 904-5, or Table 904-6 and be made from asphalt having a negative spot test result using 35% xylene / 65% heptane solvent, Aniline No: 30 C \pm 2 degrees, AASHTO T 102. It must be homogeneous and show no separation of asphalt after thorough mixing, for a period of at least 30 days after delivery.

D. Polyester Fibers for Overband Crack Fill. Provide General Certification for polyester fibers used for overband crackfill. Polyester fibers must meet the requirements of Table 904-1.

Table 904-1 Polyester Fiber Characteristics		
Characteristic	Requirement	Test
Length	6.4 mm \pm 0.05 mm	—
Crimps	None	ASTM D 3937
Tensile strength	\geq 480 MPa	ASTM D 2256 (a)
Denier	3.0–6.0	ASTM D 1577 (a)
Specific gravity	1.32–1.40	—
Melting temperature	\geq 245 °C	—
Ignition temperature	\geq 540 °C	—
a. Obtain this data before cutting the fibers.		

Table 904-2 Performance Graded Asphalt Binder Specification																
Performance Grade	PG 46					PG 52					PG 58					
	-34	-40	-46	-10	-16	-22	-28	-34	-40	-46	-16	-22	-28	-34	-40	
Avg 7-day Max. Pavement Design Temp, °C (a)	46					52					58					
Minimum Pavement Design Temp, °C (a)	-34	-40	-46	-10	-16	-22	-28	-34	-40	-46	-16	-22	-28	-34	-40	
Original Binder																
Flash Point Temp, T48/D 92: Min.	230 °C					230 °C					230 °C					
Viscosity, T 316/D 4402: Max. 3 Pa·s, Test Temp (b)	135 °C					135 °C					135 °C					
Dynamic Shear, T 315/D 7175: G*/sin θ , Min. 1.00 kPa Test Temp at 10 rad/s (c, g)	46 °C					52 °C					58 °C					
Rolling Thin Film Oven (T 240/D 2872)																
Mass Loss, Max. Percent	1.00					1.00					1.00					
Dynamic Shear, T 315/D 7175: G*/sin θ , Min. 2.20 kPa Test Temp at 10 rad/s (g)	46 °C					52 °C					58 °C					
Pressure Aging Vessel Residue (R 28/D 6521)																
PAV Aging Temp (d)	90 °C					90 °C					100 °C					
Dynamic Shear, T 315/D 7175: G*/sin θ , Max. 5,000 kPa Test Temp at 10 rad/s, °C (g)	10	7	4	25	22	19	16	13	10	7	25	22	19	16	13	
Physical Hardening (e)	Report					Report					Report					
Creep Stiffness, T 313/D 6648: S, Max. 300 MPa, m-value, Min. 0.300 Test Temp at 60 s, °C (f)	-24	-30	-36	0	-6	-12	-18	-24	-30	-36	-6	-12	-18	-24	-30	
Direct Tension, T 314/D 6723: Fail. Strain, Min. 1.0% Test Temp at 1.0 mm/min, °C (f)	-24	-30	-36	0	-6	-12	-18	-24	-30	-36	-6	-12	-18	-24	-30	

Table 904-2 Performance Graded Asphalt Binder Specification (Continued)													
Performance Grade	PG 64					PG 70							
Avg 7 day Max. Pave Design Temp (a)	-10	-16	-22	-28	-34	-40	-10	-16	-22	-28	-34	-40	
Minimum Pavement Design Temp, °C	-10	-16	-22	-28	-34	-40	-10	-16	-22	-28	-34	-40	
Original Binder													
Flash Point Temp. T48/D 92: Min.	230 °C					230 °C							
Viscosity, T 316/D 4402: Max. 3 Pa·s, Test Temp (b)	135 °C					135 °C							
Dynamic Shear, T 315/D 7175: G*/sin θ , Min. 1.00 kPa Test Temp at 10 rad/s (c,g)	64 °C					70 °C							
Rolling Thin Film Oven (T 240/D 2872)													
Mass Loss, Max. Percent	1.00					1.00							
Dynamic Shear, T 315/D 7175: G*/sin θ , Min. 2.20 kPa Test Temp at 10 rad/s (g)	64 °C					70 °C							
Pressure Aging Vessel Residue (R 28/D 6521)													
PAV Aging Temp, °C (d)	100					100 (110)							
Dynamic Shear, T 315/D 7175: G*/sin θ , Max. 5,000 kPa Test Temp at 10 rad/s, °C (g)	31	28	25	22	19	16	34	31	28	25	22	19	
Physical Hardening (e)													
Creep Stiffness, T 313/D 6648: S, Max. 300 MPa, m-value, Min. 0.300 Test Temp at 60 s, °C (f)	0	-6	-12	-18	-24	-30	0	-6	-12	-18	-24	-30	
Direct Tension, T 314/D 6723: Fail. Strain, Min. 1.0% Test Temp at 1.0 mm/min, °C (f)	0	-6	-12	-18	-24	-30	0	-6	-12	-18	-24	-30	

Table 904-2 Performance Graded Asphalt Binder Specification (Continued)												
Performance Grade	PG 76					PG 82						
	-10	-16	-22	-28	-34	-10	-16	-22	-28	-34	-10	-16
Avg 7 day Max. Pave Design Temp (a)												
Minimum Pavement Design Temp, °C	-10	-16	-22	-28	-34	-10	-16	-22	-28	-34	-10	-16
Original Binder												
Flash Point Temp, T 48/D 92: Min.												
Viscosity, T 316/D 4402: Max. 3 Pa·s, Test Temp (b)												
Dynamic Shear, T 315/D 7175: G*/sin θ , Min. 1.00 kPa Test Temp at 10 rad/s (c, g)												
Rolling Thin Film Oven (T 240/D 2872)												
Mass Loss, Max. Percent												
Dynamic Shear, T 315/D 7175: G*/sin θ , Min. 2.20 kPa Test Temp at 10 rad/s (g)												
Pressure Aging Vessel Residue (R 28/D 6521)												
PAV Aging Temp, °C (d)												
Dynamic Shear, T 315/D 7175: G*/sin θ , Max. 5000 kPa Test Temp at 10 rad/s, °C (g)												
Physical Hardening (e)												
Creep Stiffness, T 313/D 6648: S, Max. 300 MPa, m-value, Min. 0.300 Test Temp at 60 s, °C (f)												
Direct Tension, T 314/D 6723: Fail. Strain, Min. 1.0% Test Temp at 1.0 mm/min, °C (f)												

Table 904-2
Performance Graded Asphalt Binder Specification (Continued)

- a. Pavement temperatures are estimated from air temperatures using an algorithm contained in the Superpave software program, may be provided by the specifying agency, or by following the procedures as outlined in MP2 and PP28.
- b. This requirement may be waived at the discretion of the specifying agency if the supplier warrants that the asphalt binder can be adequately pumped and mixed at temperatures that meet all applicable safety standards.
- c. For quality control of unmodified asphalt cement production, measurement of the viscosity of the original asphalt cement may be used or supplement dynamic shear measurements of $G^*/\sin \theta$ at test temperatures where the asphalt is a Newtonian fluid. The Contractor may use a standard means of viscosity measurement, including capillary (T 201/D 2170 or T 202/D 2171) or rotational viscometer (T 316/D 4402).
- d. The PAV aging temperature is based on simulated climatic conditions and is one of three temperatures 90°C, 100°C or 110°C. The PAV aging temperature is 100°C for PG 58- and above, except in desert climates, where it is 110°C.
- e. Physical Hardening – T 313/D 6648 is performed on a set of asphalt beams according to Section 13.1, except the conditioning time is extended to 24 h \pm 10 min at 10°C above the minimum performance temperature. The 24 h stiffness and m-value are reported for information purposes only.
- f. If the creep stiffness is below 300 MPa, the direct tension test is not required. If the creep stiffness is from 300 MPa to 600 MPa, the direct tension failure strain requirement can be used in lieu of the creep stiffness requirement. The m-value requirement must be satisfied in both cases.
- g. $G^*/\sin \theta$ = high temperature stiffness and $G^*\sin \theta$ = intermediate temperature stiffness.

Table 904-3 Medium and Rapid Curing Cut-Back Asphalts					
Tests	Requirements				
	MC-30 (a)	MC-70 (a)	MC-250	RC-250	
Kinematic Viscosity, 60 °C, mm ² /s, T 201/D 2170	30-60	70-140	250-500	250-500	
Flash Point, deg °C:					26.7
Tag Open Cup, min, T 79	37.8	37.8	—	—	
Cleveland Open Cup, min, T 48/D 92	—	—	65.6	—	
Distillation Test, T 78/D 402					
Distillate, % by Vol of Total Distillate to 360 °C					
To 225 °C	≤25	≤20	≤10 max	≥35	
To 260 °C	40-70	20-60	15-55	≥60	
To 315.5 °C	75-93	65-90	60-87	≥80	
Residue from Distillation to 360 °C, min	50	55	67	65	
Tests on Residue from Distillation, T 78/D 402:					
Penetration at 25 °C, 100 g, 5 sec, T 49/D 5	120-250	120-250	120-250	80-120	
Ductility at 25 °C, cm, min T 51/D 113 (b)	100	100	100	100	
Solubility in Trichloroethylene, %, min, T 44/D 2042	99.5	99.5	99.5	99.5	
Spot Test, AASHTO T 102 (c)	Neg.	Neg.	Neg.	Neg.	
Section Number Reference	—	914	—	710, 914	
a. Use MC-70 grade from June 1 to September 1 and MC-30 grade other times of the year, unless otherwise directed by the Engineer.					
b. If penetration of residue exceeds 200 and ductility, at 25 °C, is less than 100, the Engineer will accept the material if ductility at 15.6 °C exceeds 100.					
c. Use 35% Xylene, 65% Heptane solvent, aniline number: 30 °C ±2 °C.					

Table 904-4 Anionic Emulsified Asphalts									
Anionic Emulsified Asphalts	Requirements								
	RS-1m	RS-2a	HFRS-2	MS-Op	MS-2h	MS-2s	SS-1h		
Viscosity, Saybolt Furol, T 59-01/D 7496:									
At 25 °C, sec	20-100	—	—	—	—	—	20-100		
At 50 °C, sec	—	50-300	50-300	15-150	50-300	50-300	—		
Storage Stability Test, T 59-01/D 6930-04, 24 hr, % Difference max	2	2	2	3	3	3	2		
Demulsibility, T 59-01/D 6936-04:									
35 ml 0.02 N CaCl ₂ , %	20-60	≥60	≥40	—	—	—	—		
50 ml 0.1 N CaCl ₂ , %	—	—	—	—	—	—	≤2		
50 ml 0.02 N CaCl ₂ , %	—	—	—	—	—	—	—		
Sieve Test, T 59-01/D 6933-04, % max	0.10	0.10	0.10	0.10	0.10	0.10	0.10		
Miscibility with Water, D 244 (a)	—	—	—	—	—	—	Yes		
Distillation to 260°C, T 59-01/D 6997-04, % by Weight:									
Residue, Min	65	65	65	65	65	65	60		
Oil Distillate, max	2	2	2	25	7	7	2		
Tests on Distillation Residue:									
Penetration, 25 °C, 100 g, 5 sec, dmm, T 49/D 5	100-200	100-200	100-200	(b)	150-300	≥300	40-90		
Float Test, sec, T 50/D 139:									
At 50 °C, max	—	—	—	200	—	—	—		
At 60 °C, min	—	—	1,200	—	1,200	1,200	—		
Ductility, 25 °C, cm, min, T 51/D 113	60	60	60	40 (b)	—	—	40		
Solubility in Trichloroethylene, % min, T 44/D 2042	97.5	97.5	97.5	97.5	97.5	97.5	97.5		
Ash Content, %, max, D 128	2	2	2	2	2	2	2		
Specific Gravity, 25/25 °C, min., T 228/D 70	0.996	0.996	0.996	—	—	—	—		
Toughness/Tenacity, 25 °C, 50 cm/min., Nm, min., D 5801	—	—	—	—	—	—	—		
Elastic Recovery, 10 °C, % min., T 301/D 6084	—	—	—	—	—	—	—		
Section Number Reference	—	401	—	501	—	501	501, 805		
a. No appreciable coagulation or visible separation in 2 hours.									
b. Heat the distillation residue (ASTM D 243) to 100±15 penetration within 2 hours, and have a ductility of at least 40 cm.									

Table 904-5 Cationic Emulsified Asphalts				
Cationic Emulsified Asphalts	Requirements			
	CRS-1	CRS-2	CMS-2	CSS-1h
Viscosity, Saybolt Furol, T 59-01/D 7496:				
At 25 °C, sec	—	—	—	20–100
At 50 °C, sec	20–100	100–400	50–450	—
Storage Stability Tests, T 59-01/D 6930-04, 24 hr, % Difference, max	1	1	1	1
Demulsibility, %, 35 ml 0.8% Dioctyl Sodium Sulfosuccinate, min, T 59-01/D 6936-04, (a)	40	40	—	—
Particle Charge Tests, T 59-01/D 7402 (b)	Positive	Positive	Positive	Positive
Sieve Tests, T 59-01/D 6933-04, % max (Distilled Water)	0.10	0.10	0.10	0.10
Distillation to 260 °C, T 59-01/D 6997-04, % by Weight (c)	—	—	—	—
Residue, min	60	65	65	60
Oil Distillate, max	3	3	12	—
Tests on Distillation Residue:				
Penetration, 25 °C, 100 g, 5 sec, dmm, T 49/D 5	100–250	100–250	100–250	40–90
Ductility, 25 °C, 5 cm/min, cm, min, T 51/D 113	40	40	40	40
Ductility, 4 °C, 5 cm/min, cm, T 51/D 113	—	—	—	—
Elastic/Recovery, 4 °C, % min, T 301/D 6084	—	—	—	—
Solubility in Trichloroethylene, % min, T 44/D 2042	97.5	97.5	97.5	97.5
Ash Content, % max, D 128	2	2	2	2
Specific Gravity, 25/25 °C, min, T 228/D 70	0.996	0.996	—	—
Toughness/Tenacity, 25 °C, 50 cm/min., Nm, min., D 5801	—	—	—	—
Elastic Recovery, 10 °C, % min., T 301/D 6084	—	—	—	—
Cement Mixing Test, T 59-01/D 6935-04, % max	—	—	—	2.0
Coating Ability and Water Resistance:				
Coating Dry Aggregate	—	—	Good	—
Coating After Spraying	—	—	Good	—
Coating Wet Aggregate	—	—	Fair	—
Coating After Spraying	—	—	Fair	—
Section Number Reference	—	—	501	501, 805
a. The Demulsibility Test must be made within 30 days from date of shipment.				
b. If Particle Charge Test is inconclusive, material having a maximum pH of 6.7 is acceptable.				

Table 904-6 Capital Preventative Maintenance (CPM) Emulsions (h)						
	Requirements					
	HFRS-2M	CRS-2M	CSS-1mM	CSS-1hM	PPSS	CSEA
Viscosity, Saybolt Furol, T 59-01/D 7496:						
At 25 °C, sec	—	—	20-100	20-100	20-100	—
At 50 °C, sec	75-300	75-300	—	—	—	75-400
Storage Stability Test, T 59-01/D 6930-04, 24 hr, % Difference max	1	1	1	1	1 (g)	1
Demulsibility, T 59-01/D 6936-04:						
35 ml 0.8% Dioctyl Sodium Sulfosuccinate, % min (a)	—	50	—	—	60	50
35 ml 0.02 N CaCl ₂ , %, min.	—	—	—	—	60	—
50 ml 0.1 N CaCl ₂ , %	—	—	—	—	—	—
50 ml 0.02 N CaCl ₂ , %	≥50	—	—	—	—	—
Particle Charge Tests, T 59-01/D 7402 (b)	—	Positive	Positive	Positive	—	Positive
Sieve Test, T 59-01 / D 6933-04, % max	0.10	0.10	0.10	0.10	0.05	0.10
Miscibility with Water, D 244 (f)	—	—	—	—	—	—
Distillation to 260°C, T 59-01/D 6997-04, % by Weight:	(e)	(e)(j)	(e)	(e)	(e)	(l)
Residue, Min	65	65	62	62	63	68
Oil Distillate, ml, max, D 244	2	3	—	—	2	3.0
Tests on Distillation Residue:						
Penetration, 25 °C, 100 g, 5 sec, dmm, T 49/D 5	80-150	80-150	70-90	40-90	80-150	70-100
Ductility, 25 °C, 5 cm/min, cm, T 51/D 113	—	—	40	40	—	40
Ductility, 4 °C, 5 cm/min, cm, T 51/D 113	—	—	35	—	—	—
Elastic/Recovery, 4 °C, % min, T 301/D 6084	—	—	65	—	—	—
Float Test, sec, T 50/D 139:						
At 50 °C, max	—	—	—	—	—	—
At 60 °C, min	1,200	—	—	—	—	—
Solubility in Trichloroethylene, % min, T 44/D 2042	—	—	97.5	97.5	—	97.5
Ash Content, %, max, D 128	2	2	2	2	—	2
Specific Gravity, 25/25 °C, min., T 228/D 70	—	—	—	—	—	—
Toughness/Tenacity, 25 °C, 50 cm/min., Nm, min., D 5801	4.5/3.5	4.5/3.5	—	—	—	9.0/7.0
Elastic Recovery, 10 °C, % min., T 301/D 6084	60%	60%	—	—	60	75
Tests on Residue from Evaporation, T 59-01/D 6934-04: (c)						
Softening Point, Ring & Ball, °C, min., T 53/D 36	—	—	60	57.2	—	—
Viscosity, 60C, Pa·S, T 202/D 2171	—	—	800 (d)	800 (d)	—	—
Section Number Reference	505	505	507	507	—	—
<p>a. The Demulsibility Test must be made within 30 days from date of shipment.</p> <p>b. If Particle Charge Test is Inconclusive, material having a maximum pH of 6.7 is acceptable.</p> <p>c. Residue by evaporation: Oven evaporate an emulsion sample on a glass plate at a maximum temperature of 60 °C for 24 hours (forced draft oven recommended) or air dry the sample at ambient temperature for three days. Once dry, the sample is scraped from the plate using a razor blade tool.</p> <p>d. The minimum Viscosity will be obtained using a Cannon-Manning Vacuum Capillary Viscometer Tube No. 14 per T 202 / D 2171.</p> <p>e. ASTM D 6997, with modifications to include a 204 °C (± 6 °C) maximum temperature to be held for 15 minutes.</p> <p>f. No appreciable coagulation or visible separation in 2 hours.</p> <p>g. After standing undisturbed for 24 hours, the surface must show no white, milky colored substance, but must be a smooth homogenous color throughout. Any visible amount of white, milky colored substance is basis for non-acceptance.</p> <p>h. Samples of emulsified asphalt will be taken in accordance with ASTM D 140. Samples must be stored at a temperature of not less than 4 °C until tested.</p> <p>i. Residue determination and preparation may use the alternate ASTM D 6934 method, "Residue by Evaporation" so as to not destroy the properties of any polymer modifiers contained therein.</p>						

904.03

Table 904-7 Temperatures for Asphaltic Materials		
Asphalt Type	Designation	Temperature, °F Distributor
Cut-Back Asphalts	RC-250	145–220
	MC-250	145–220
	MC-30	70–140
	MC-70	105–180
Emulsified	RS-1m, SS-1h, CSSmM, CRS-1, CSS-1h, CSS-1hM,	85–135
Asphalts	RS-2a, HFRS-2, HFRS-2M, MS-2h, MS-2s, CRS-2, CMS-2, CRS-2M	125–175
Asphalt Binder	All Grades	350 Maximum Mixing Temp (a)
a. Mixing temperature for all asphalt binders will be as specified by the modifier/binder producer.		

JUN 30 2016

FAA, DETROIT ADO

Letter of Transmittal

To: Ms. Irene Porter
FAA Metro Airport Center
11677 South Wayne Road, Suite 107
Romulus, MI 48174

From: Bob Nelesen, P.E.

Date: June 29, 2016

Project #: 2160331

Re: Ford Airport - Rehabilitate Runway 13/31 and Remark Airfield
Federal No. 3-26-0049-2016

We are enclosing the following:

<i>Copies</i>	<i>Date</i>	<i>Description</i>
1		Modification of Airport Design Standards

These are transmitted: ☐ for approval ☒ for your use ☐ _____

Remarks:

Signature page to arrive under separate cover from Ford Airport (IMT).

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Signed: Bob Nelesen

